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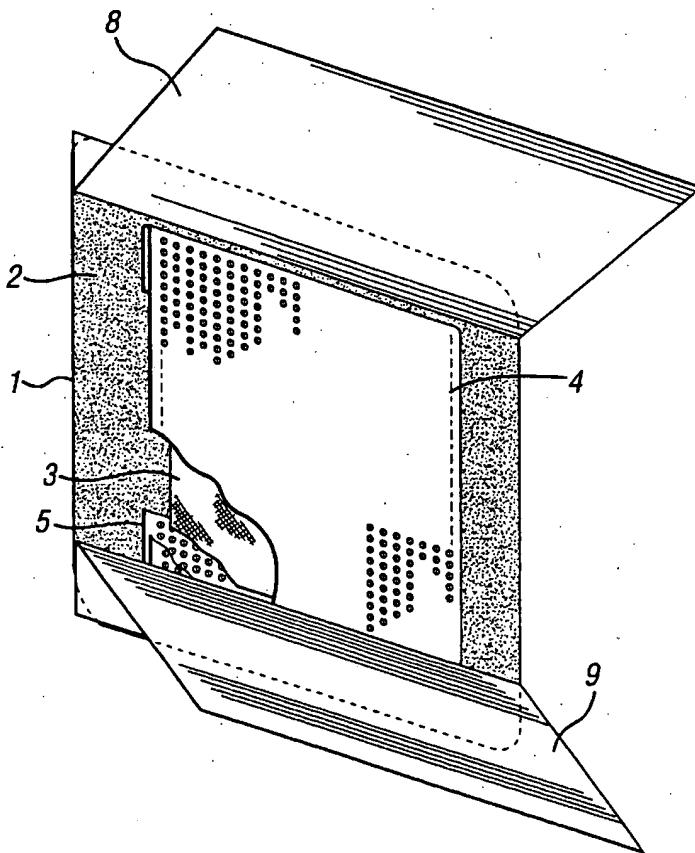
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(54) Title: HYDROGEL WOUND DRESSINGS



(57) Abstract: The invention provides a wound dressing comprising: a liquid-permeable top sheet having a wound facing surface and a back surface, said top sheet being adapted to block or restrict passage of liquid from the back surface to the wound facing surface; and an insoluble hydrogel layer on the wound facing surface of the top sheet.

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HYDROGEL WOUND DRESSINGS

The present invention relates to wound dressings incorporating an absorbent structure and a hydrogel layer for the maintenance of a suitable 5 moisture level at the surface of wounds.

It is known that the maintenance of a moist wound environment promotes the healing of wounds, especially burns and chronic wounds such as ulcers. However, it is also desirable to avoid excessive moisture or pooling of wound 10 exudate on the wound, since liquid exudate causes maceration of skin adjacent to the wound and other difficulties. Furthermore, liquid exudate can leak from the wound site and contaminate clothes or bedding.

In practice, it is difficult to maintain the desired moisture level at the wound 15 site because the rate of wound fluid production varies from wound to wound, and over time for any single wound. This can necessitate frequent dressing changes and a range of dressing types to treat different wounds.

It is an object of the present invention to provide structures for use as or in 20 improved multilayer dressings for the treatment of a wide range of wounds.

The present invention provides a wound dressing comprising: a liquid-permeable top sheet having a wound facing surface and a back surface, said top sheet being adapted to block or restrict passage of liquid from the back surface to 25 the wound facing surface; and a hydrogel layer on the wound facing surface of the top sheet.

Preferably, the dressing further comprises a backing layer over the back face of the top sheet. The backing layer supports the top sheet and an 30 intermediate absorbent layer (where present) and preferably provides a barrier to passage of microorganisms through the dressing. The backing layer may extend beyond at least one edge of the absorbent layer to provide an adhesive-coated margin adjacent to the said edge for adhering the dressing to a surface, such as to

the skin of a patient adjacent to the wound being treated. An adhesive-coated margin may extend around all sides of the absorbent layer, so that the dressing is a so-called island dressing. However, it is not necessary for there to be any adhesive-coated margin.

5

Preferably, the backing layer is substantially liquid-impermeable. The backing sheet is preferably semipermeable. That is to say, the backing sheet is preferably permeable to water vapour, but not permeable to liquid water or wound exudate. Preferably, the backing sheet is also microorganism-impermeable.

10 Suitable continuous conformable backing sheets will preferably have a moisture vapor transmission rate (MVTR) of the backing sheet alone of 300 to 5000 g/m²/24hrs, preferably 500 to 2000 g/m²/24hrs at 37.5 °C at 100% to 10% relative humidity difference. The backing sheet thickness is preferably in the range of 10 to 1000 micrometers, more preferably 100 to 500 micrometers.

15

The MVTR of the dressing according to the present invention as a whole is lower than that of the backing sheet alone, because the top sheet partially obstructs moisture transfer through the dressing. Preferably, the MVTR of the dressing (measured across the island portion of the dressing) is from 20% to 80% of the MVTR of the backing sheet alone, more preferably from 20% to 60% thereof, and most preferably about 40% thereof. It has been found that such moisture vapor transmission rates allow the wound under the dressing to heal under moist conditions without causing the skin surrounding the wound to macerate.

25

Suitable polymers for forming the backing sheet include polyurethanes and poly alkoxyalkyl acrylates and methacrylates such as those disclosed in GB-A-1280631. Preferably, the backing sheet comprises a continuous layer of a high density blocked polyurethane foam that is predominantly closed-cell. A suitable 30 backing sheet material is the polyurethane film available under the Registered Trade Mark ESTANE 5714F.

The adhesive (where present) layer should be moisture vapor transmitting and/or patterned to allow passage of water vapor therethrough. The adhesive layer is preferably a continuous moisture vapor transmitting, pressure-sensitive adhesive layer of the type conventionally used for island-type wound dressings, for 5 example, a pressure sensitive adhesive based on acrylate ester copolymers, polyvinyl ethyl ether and polyurethane as described for example in GB-A-1280631. The basis weight of the adhesive layer is preferably 20 to 250 g/m², and more preferably 50 to 150 g/m². Polyurethane-based pressure sensitive adhesives are preferred.

10

Preferably, the adhesive layer extends outwardly from the absorbent layer and the envelope to form an adhesive-coated margin on the backing sheet around the adhesive layer as in a conventional island dressing.

15

The area of the optional absorbent layer is typically in the range of from 1cm² to 200cm², more preferably from 4cm² to 100cm².

20

The optional absorbent layer may be any of the layers conventionally used for absorbing wound fluids, serum or blood in the wound healing art, including gauzes, nonwoven fabrics, superabsorbents, hydrogels and mixtures thereof. Preferably, the absorbent layer comprises a layer of absorbent foam, such as an open celled hydrophilic polyurethane foam prepared in accordance with EP-A-0541391, the entire content of which is expressly incorporated herein by reference. In other embodiments, the absorbent layer may be a nonwoven fibrous web, for example a carded web of viscose staple fibers. The basis weight of the absorbent layer may be in the range of 50-500g/m², such as 100-400g/m². The uncompressed thickness of the absorbent layer may be in the range of from 0.5mm to 10mm, such as 1mm to 4mm. The free (uncompressed) liquid absorbency measured for physiological saline may be in the range of 5 to 30 g/g 25 at 25°C.

The optional absorbent layer may additionally comprise one or more active therapeutic or antimicrobial agents. Suitable therapeutic agents include growth

factors, analgesics, local anaesthetics and steroids. Suitable antimicrobial agents include antiseptics such as silver compounds (e.g. silver sulfadiazine) and chlorhexidine, and antibiotics. The therapeutic or antimicrobial agents are usually added in an amount of from 0.01% to 5% by weight, based on the dry weight of

5 the absorbent layer. Provision of the antimicrobial in the absorbent layer may be preferable for two reasons (1) Simple manufacturing route, and (2) Having the antimicrobial away from the wound would prevent unnecessary exposure to the antimicrobial when it may not be needed, e.g. drier wounds. In the presence of higher exudate, higher levels of the antimicrobial will be released as the absorbent

10 layer becomes wet. Whilst the directional top sheet should restrict the flow of exudate back to the wound (to some extent through surface tension of the liquid), the antimicrobial should go against the concentration gradient and pass back through the perforated sheet and into the wound. It is known that antimicrobial components such as silver ions can be transported through relatively low levels of

15 moisture.

The top sheet of the wound dressing according to the invention is liquid permeable, but acts to block or restrict the flow of liquid from the back surface to the wound site. That is to say, the top sheet allows fluid to pass through the top sheet from the wound site, but blocks or restricts flow of the fluid back through the top sheet onto the wound (also known as wet-back). Such non-wetting or top sheets may for example be made from porous non-woven fabrics comprising a layer of hydrophobic fibers, or having a hydrophobic finish applied to at least the outer surface thereof. Preferably, the top sheet has greater liquid permeability to

20 the flow of liquid away from the wound facing surface than to the flow of liquid towards the wound facing surface.

25

Preferably, the top sheet is formed from a substantially liquid-impermeable sheet material provided with tapered capillaries, each capillary having a base

30 substantially in the plane of the wound facing surface of the top sheet and an apical opening remote from the wound facing surface of the top sheet and preferably in contact with an absorbent layer. The conical capillaries provide

rapid one-way wicking of fluid from the front of the top sheet, with minimal wet-back. Top sheets of this type are described in GB-A-1526778.

The top sheet film may be formed from a thermoplastic film-forming 5 polymer. Preferably, the polymer is conformable but not substantially elastomeric. Suitable polymers include, but are not limited to, polyethylene, polypropylene, polyester, polyamides such as nylons, fluoropolymers such as polyvinylidene fluoride (PVDF) or polytetrafluoroethylene (PTFE), and mixtures thereof. The top sheet is preferably a polyolefin film. Preferably, the film has a thickness by weight 10 (ASTM E252-84) of from 10 to 200 micrometers, more preferably from 25 to 100 micrometers.

Preferably, the capillaries are substantially in the form of truncated cones. Preferably, the capillaries have a base opening dimension (the maximum opening 15 dimension in the plane of the top sheet) of from 0.1 mm to 3 mm, and an apical opening dimension (remote from the plane of the top sheet) of from 0.05 to 2 mm. More preferably, the capillaries have a base opening dimension as herein defined of from 0.3 mm to 1 mm, and an apical opening dimension of from 0.1 to 0.5 mm.

20 Preferably, the capillaries have an average angle of taper (measured from the perpendicular to the plane of the top sheet) of from 10 to 60 degrees. Preferably, the embossed thickness of the top sheet (by ASTM D374-79) is from 0.2 to 2 mm, more preferably from 0.4 to 1 mm.

25 Top sheets of this type may be manufactured, for example, by embossing or vacuum perforation of a liquid-impermeable thermoplastic film. Preferably, the density of the capillaries is from 10 to 400 per cm^2 , more preferably from 50 to 200 per cm^2 . Preferably, the open area of the top sheet is from 5 to 50% of the total area, more preferably from 10 to 25% of the total area.

30

It has now been found, surprisingly, that the application of a hydrogel layer to the top surface of such a top sheet enables a moist wound environment to be maintained for prolonged periods, over a wide range of wound exudation rates.

The top sheet continues to wick away wound fluid to prevent excessive moisture in the wound, but this does not result in removal of the hydrogel or blocking of the top sheet by the hydrogel. When the rate of wound exudate production falls, the hydrogel absorbs moisture vapor from the absorbent layer and preserves a moist 5 wound contacting surface. The hydrogel does not give rise to substantially increased wet-back through the top sheet.

Preferably, the hydrogel layer has a dry basis weight of from 10 to 200g/m², more preferably from 10 to 100g/m², and most preferably from 10 to 10 50g/m².

The term "hydrogel layer" refers generally to layers that interact with the wound surface under physiological conditions to maintain an elevated moisture level at the wound surface. Preferably, the hydrogel layer forms a gel with water 15 under physiological conditions of temperature and pH. Such hydrogel layers can be formed by the inclusion of medically acceptable macromolecular materials that preferably have the ability to swell and absorb fluid while maintaining a strong integral structure. The hydrogel material is substantially insoluble in water under physiological conditions, whereby the hydrogel is not washed away by the wound 20 fluid. The hydrogel may be a biopolymer, and/or it may be bioabsorbable. That is to say, it may undergo gradual resorption *in vivo*.

Exemplary insoluble gels include certain cross-linked polyacrylate gels, calcium alginate gels, cross-linked hyaluronate gels, wherein the hydrogel layer 25 comprises a hydrogel material selected from gels formed from vinyl alcohols, vinyl esters, vinyl ethers and carboxy vinyl monomers, meth(acrylic) acid, acrylamide, N-vinyl pyrrolidone, acylamidopropane sulphonic acid, PLURONIC (Registered Trade Mark) (block polyethylene glycol, block polypropylene glycol) polystyrene-, maleic acid, NN-dimethylacrylamide diacetone acrylamide, acryloyl morpholine, 30 and mixtures thereof. Preferably, the gel adheres strongly to the surface of the top sheet material to resist washing off by wound fluid. In certain embodiments the gel may be chemically bonded to the surface of the top sheet.

Preferably, the hydrogel layer comprises a hydrogel material selected from polyurethane gels, biopolymer gels, carboxymethyl cellulose gels, hydroxyethyl cellulose gels, hydroxy propyl methyl cellulose, modified acrylamide and mixtures thereof. Suitable biopolymer gels include alginates, pectins, galactomannans, 5 chitosan, gelatin, hyaluronates and mixtures thereof. Some of these biopolymer materials also promote wound healing.

Preferably, the gels are cross-linked, and the cross-linking may be either covalent or ionic.

10

Preferably, the hydrogel material further comprises from 5 to 50% by weight on a dry weight basis of one or more humectants such as glycerol.

Preferably, the hydrogel layer comprises a hydrogel material of the kind 15 described in WO00/07638, the entire contents of which is incorporated herein by reference.

Alternatively or additionally to the gel-forming macromolecules, the hydrogel layer may comprise one or more emollients. Emollients are used to smooth the 20 surface of skin and to increase the degree of hydration. They act either by occluding water loss from the outer layer of the skin, or by improving water binding to the skin. Emollients are particularly useful in the treatment of atopic eczemas and ichthyoses. Preferred emollients include White Soft Paraffin, Yellow Soft Paraffin, Liquid paraffin, Urea Creams, Lanolin, Sodium Pyrrolidone Carboxylate 25 (PCA Na), Evening primrose extract (gamma linolenic acid), Soya Oil, Tea Tree Oil, Coconut Oil, Almond Oil, Camomile Extract, Cod Liver Oil, Peanut Oil, Emu Oil, Aloe Vera, Sunflower oil, Avocado Oil, Jojoba Oil, Cocoamide, and mixtures thereof.

30 The hydrogel layer may additionally comprise one or more active therapeutic or antimicrobial agents. Suitable therapeutic agents include growth factors, analgesics, local anaesthetics and steroids. Suitable antimicrobial agents include antiseptics such as silver compounds (e.g. silver sulfadiazine) and

chlorhexidine, and antibiotics. The therapeutic or antimicrobial agents are usually added in an amount of from 0.01% to 5% by weight, based on the dry weight of the hydrogel layer.

5 The hydrogel layer may be continuous or discontinuous, but in any case is preferably apertured in register with the capillaries in the top sheet so as not to obstruct passage of fluid into the capillaries even when the hydrogel is fully swelled. In other words, there is preferably substantially no hydrogel initially present in or covering the capillaries of the top sheet. The hydrogel layer may be
10 applied by spraying or, preferably, by a printing or transfer process.

Preferably, the multilayer wound dressing according to the invention further comprises one or more protective cover sheets over the hydrogel layer and any exposed adhesive. For example, these may comprise one or more release-coated
15 paper cover sheets. Preferably, the dressing is sterile and packaged in a microorganism-impermeable container.

The present invention further provides the use of a multilayer wound dressing according to the present invention for the preparation of a dressing for
20 application to a wound.

In a further aspect, the present invention provides a method of treatment of a wound comprising the step of applying a dressing in accordance with the present invention to the surface of the wound with the hydrogel contacting the wound.

An embodiment of the present invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

5 Figure 1 shows a perspective view of the lower (wound contacting) surface of a wound dressing according to the invention; and

10 Figure 2 shows a partial transverse cross section (not to scale) through the island region of the dressing of Figure 1.

15 Referring to Figure 1, the wound dressing is an island-type self-adhesive wound dressing comprising a backing layer 1 of microporous liquid-impermeable polyurethane foam, such as ESTANE 5714F (Registered Trade Mark). The backing layer is permeable to water vapor, but impermeable to wound exudate and microorganisms.

20 The backing layer 1 is coated with a substantially continuous layer 2 of pressure-sensitive polyurethane adhesive.

25 The absorbent layer 3 is a layer of hydrophilic polyurethane foam prepared as described in EP-A-0541391 and having a basis weight of about 350g/m^2 and a thickness of about 1.5 mm.

30 The top sheet 4 extends over the absorbent layer 3 and is wrapped partially around the absorbent layer 3 and the edges 5 of the top sheet are adhered to the backing layer 1 behind the absorbent layer 3 by the adhesive 2. This can be seen more clearly in Figure 2. The top sheet is a polyethylene film that has been perforated with about 90 perforations per cm^2 , each perforation having a substantially conical shape as hereinbefore described, a maximum hole diameter of about 0.5 mm, an open area of 16% of the total area of the front face, a thickness by weight of about 43 micrometers and an embossed thickness of about 0.5 mm. Such top sheets are available from Tredegar Film Products, Richmond, Virginia under the Registered Trade Mark VISPORE.

Referring to Figure 2, the top sheet 4 presents a smooth, perforated top surface to the wound. This surface is coated with a layer of hydrogel 6 applied by spraying that is apertured in register with the capillaries in the top sheet to allow passage of fluid into the capillaries even when the hydrogel is fully swelled. The 5 hydrogel 6 has a dry basis weight of 30g/m² and consists of bovine gelatin cross-linked with glutaraldehyde or formaldehyde.

The wound facing surface of the dressing shown in Figure 1 is protected by two silicone-coated release papers 8,9, packed in a microorganism-impermeable 10 pouch, and sterilised using gamma radiation.

In use, the dressing is removed from the package, the release papers are removed, and the dressing is adhered to the skin around the wound with the top sheet and hydrogel in contact with the wound to provide a sterile and absorbent 15 dressing. The hydrogel and top sheet interact in hitherto unexpected ways to provide a moist but not wet wound environment for a wide range of wounds over an extended period.

The above embodiment has been described by way of example only. Many 20 other embodiments falling within the scope of the accompanying claims will be apparent to the skilled reader.

CLAIMS

1. A wound dressing comprising: a liquid-permeable top sheet having a wound facing surface and a back surface, said top sheet being adapted to block or restrict passage of liquid from the back surface to the wound facing surface; and a hydrogel layer on the wound facing surface of the top sheet.
2. A wound dressing according to claim 1, further comprising an absorbent layer in contact with the back surface of the top sheet.
3. A wound dressing according to any preceding claim, wherein the absorbent layer comprises a layer of hydrophilic foam, a superabsorbent, or a combination thereof.
4. A wound dressing according to claim 2 or 3, wherein the absorbent layer further comprises a medicament.
5. A wound dressing according to any preceding claim, wherein the dressing further comprises a substantially liquid-impermeable backing layer over the absorbent layer.
6. A wound dressing according to claim 5, further comprising a layer of adhesive on the surface of the backing layer facing the top sheet.
7. A wound dressing according to claim 6, wherein the backing layer extends beyond at least one edge of the absorbent layer to provide an adhesive-coated margin adjacent to said edge for adhering the dressing to a surface.
8. A wound dressing according to any preceding claim, wherein the top sheet comprises a porous, substantially hydrophobic, non-woven fabric.
9. A wound dressing according to any preceding claim, wherein the top sheet is formed from a liquid-impermeable sheet material provided with tapered

capillaries, each capillary having a base substantially in the wound facing surface of the top sheet and an apical opening remote from the plane of the top sheet and in contact with the absorbent layer.

5 10. A wound dressing according to claim 9, wherein the capillaries are substantially in the form of truncated cones.

11. A wound dressing according to claim 9 or 10, wherein the capillaries have a base opening dimension as herein defined of from 0.15 mm to 6 mm, and an 10 apical opening dimension of from 0.1 to 2.5 mm.

12. A wound dressing according to claim 11, wherein the capillaries have a base opening dimension as herein defined of from 0.5 mm to 1.5 mm, and an apical opening dimension of from 0.1 to 0.5 mm.

15 13. A wound dressing according to any of claims 9 to 12, wherein the capillaries have an average angle of taper as herein defined of from 10 to 60 degrees.

20 14. A wound dressing according to any preceding claim, wherein the hydrogel layer has a dry basis weight of from 10 to 200g/m².

25 15. A wound dressing according to any preceding claim, wherein the hydrogel layer comprises a hydrogel material selected from polyurethane gels, biopolymer gels, carboxymethyl cellulose gels, hydroxyethyl cellulose gels hydroxypropyl methyl cellulose, modified acrylamides and mixtures thereof.

30 16. A wound dressing according to any preceding claim, wherein the hydrogel layer comprises a hydrogel material selected from gels formed from vinyl alcohols, vinyl esters, vinyl ethers and carboxy vinyl monomers, meth(acrylic) acid, acrylamide, N-vinyl pyrrolidone, acylamidopropene sulphonic acid, pluronic (block polyethylene glycol, block polypropylene glycol)polystyrene maleic acid, NN-dimethylacrylamide, diacetone acrylamide or acryloyl morpholine.

17. A wound dressing according to any preceding claim, wherein the hydrogel layer comprises an emollient.
18. A wound dressing according to claim 17, wherein the emollient is selected from the group consisting of white soft paraffin, yellow soft paraffin, liquid paraffin, urea creams, lanolin, sodium pyrrolidone carboxylate, evening primrose extract (gamma linolenic acid), soya oil, tea tree oil, coconut oil, almond oil, camomile extract, cod liver oil, peanut oil, emu oil, aloe vera, sunflower oil, avocado oil, jojoba oil, cocoamide, and mixtures thereof.
- 10
19. A wound dressing according to any preceding claim, wherein the hydrogel layer comprises an active therapeutic agent or an antimicrobial agent.
20. A wound dressing according to claim 19, wherein the hydrogel layer comprises a silver compound.
- 15
21. A wound dressing according to any preceding claim, wherein the hydrogel layer is apertured in register with apertures in the top sheet.
- 20
22. A wound dressing according to any preceding claim, further comprising one or more protective cover sheets over the hydrogel layer.
23. A wound dressing according to any preceding claim, wherein the dressing is sterile and packaged in a microorganism-impermeable container.
- 25
24. Use of a wound dressing according to any preceding claim for the preparation of a dressing for application to a wound.

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FIG. 1

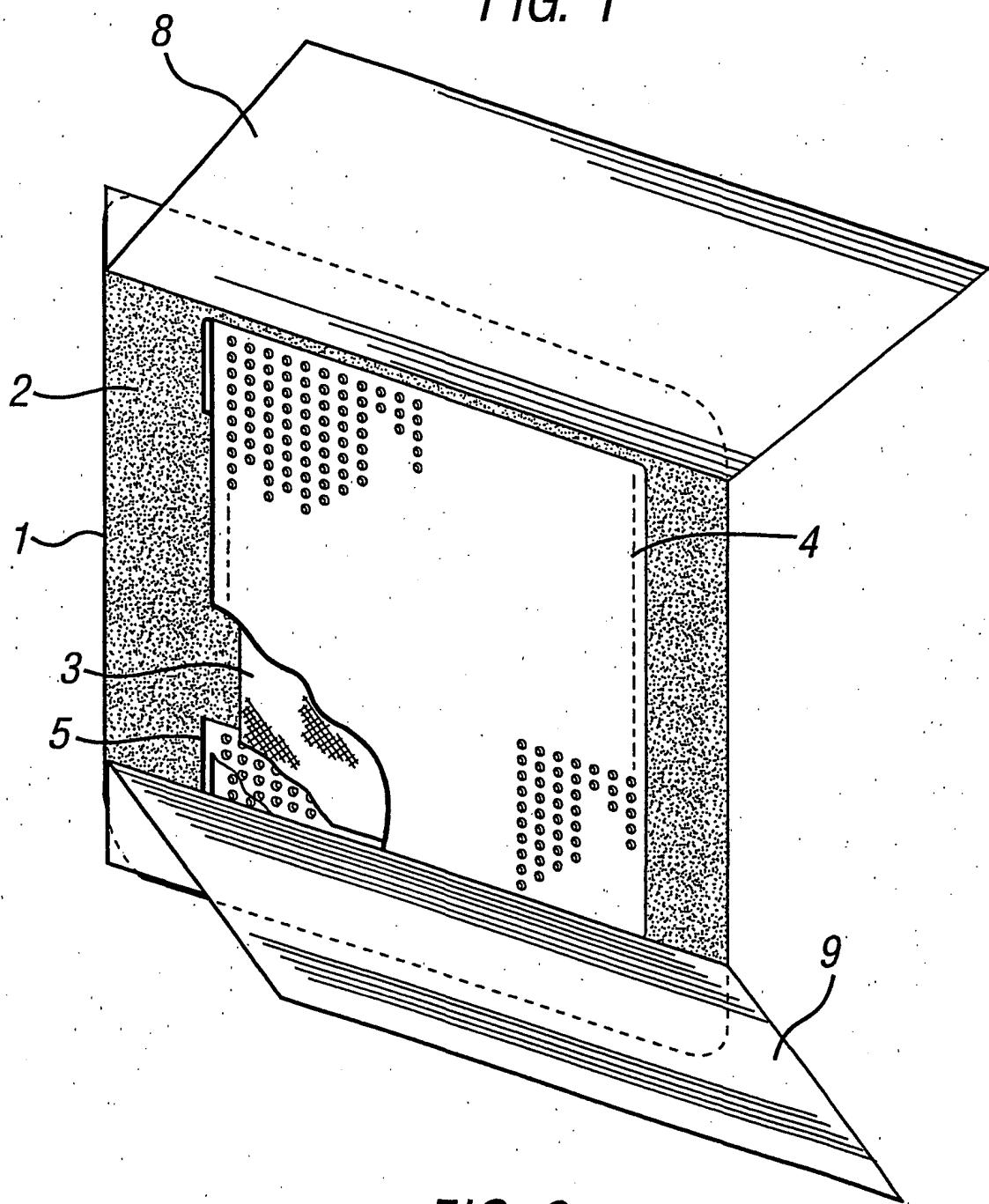
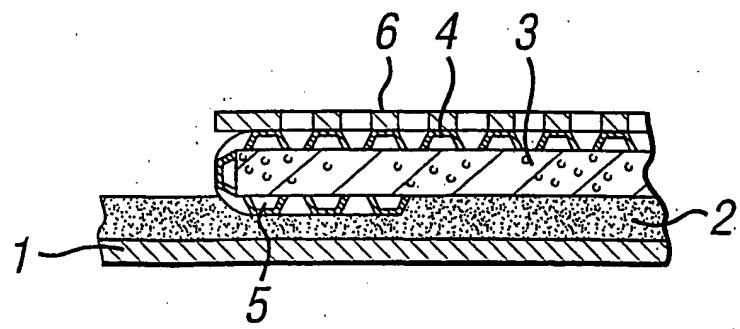


FIG. 2



A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 010 883 A (POTTER WILLIAM D ET AL) 30 April 1991 (1991-04-30) column 1, line 10 - line 35 column 5, line 35 -column 8, line 68 column 9, line 25 -column 10, line 39	1-7, 21-24
Y	column 11, line 54 -column 12, line 49; claims; figures ---	8-20
Y	US 3 929 135 A (THOMPSON HUGH ANSLEY) 30 December 1975 (1975-12-30) cited in the application column 4, line 1 - line 62; figures ---	8-14

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 990 144 A (BLOTT PATRICK L) 5 February 1991 (1991-02-05) column 1, line 21 -column 2, line 53 column 5, line 4 -column 6, line 39 claims; figures ---	15-20
A	US 5 204 110 A (ALLAIRE MICHAEL J ET AL) 20 April 1993 (1993-04-20) column 5, line 22 -column 7, line 63 ---	1,14-16
A	US 4 341 207 A (STEER PETER L ET AL) 27 July 1982 (1982-07-27) the whole document ---	1-24
A	US 5 423 736 A (WOLF MICHAEL L ET AL) 13 June 1995 (1995-06-13) claims; figures ---	1-24
A	US 5 540 922 A (FABO TOMAS) 30 July 1996 (1996-07-30) claims; figures ---	1-24
A	US 5 465 735 A (PATEL HARISH A) 14 November 1995 (1995-11-14) claims; figures ---	1,9
A	EP 0 536 875 A (NDM ACQUISITION CORP) 14 April 1993 (1993-04-14) claims; figures ---	1-24
A	US 5 501 661 A (CARTMELL JAMES V ET AL) 26 March 1996 (1996-03-26) claims; figures ---	1-24

Patent document cited in search report	Publication date		Patent family member(s)	Publication date
US 5010883	A 30-04-1991	AT AU AU CA DE EP JP JP JP NZ ZA	60897 T 566415 B2 3684084 A 1290210 A1 3484133 D1 0147119 A2 1857260 C 5055144 B 60222054 A 210533 A 8409752 A	15-03-1991 22-10-1987 27-06-1985 08-10-1991 28-03-1991 03-07-1985 07-07-1994 16-08-1993 06-11-1985 31-07-1987 31-07-1985
US 3929135	A 30-12-1975	AT AT AT AT AU BE BR CA CH DE DK ES FI FR GB IE IT JP JP JP LU MX NL SE ZA	369238 B 587078 A 351156 B 945975 A 8709175 A 836857 A1 7508479 A 1058801 A1 595830 A5 2556501 A1 583675 A ,B, 217535 Y 753610 A ,B, 2294656 A1 1526778 A 41963 B1 1051534 B 1133476 C 51108943 A 57017081 B 74067 A1 144813 A 7514895 A ,C 7514345 A 7507380 A	10-12-1982 15-05-1982 10-07-1979 15-12-1978 02-06-1977 21-06-1976 24-08-1976 24-07-1979 28-02-1978 01-07-1976 21-06-1976 01-03-1977 21-06-1976 16-07-1976 27-09-1978 07-05-1980 20-05-1981 27-01-1983 27-09-1976 08-04-1982 11-11-1976 24-11-1981 22-06-1976 21-06-1976 26-01-1977
US 4990144	A 05-02-1991	AT AU AU CA DE DE EP ES GB IE JP JP ZA	106710 T 601471 B2 7719087 A 1323268 A1 3789998 D1 3789998 T2 0256893 A2 2054680 T3 2194446 A ,B 61186 B 2513712 B2 63051865 A 8706101 A	15-06-1994 13-09-1990 25-02-1988 19-10-1993 14-07-1994 12-01-1995 24-02-1988 16-08-1994 09-03-1988 19-10-1994 03-07-1996 04-03-1988 22-02-1988
US 5204110	A 20-04-1993	US AT AU AU CA DE	5115801 A 123402 T 620750 B2 7026991 A 2035490 A1 69110193 D1	26-05-1992 15-06-1995 20-02-1992 07-11-1991 03-11-1991 13-07-1995

Patent document cited in search report	Publication date		Patent family member(s)		Publication date
US 5204110	A		DE 69110193 T2 EP 0455324 A1 JP 1988560 C JP 4227259 A JP 7024671 B NZ 237005 A		19-10-1995 06-11-1991 08-11-1995 17-08-1992 22-03-1995 28-04-1993
US 4341207	A	27-07-1982	AU 537462 B2 AU 6159780 A CA 1151041 A1 DE 3065372 D1 DK 379780 A, B, EP 0026572 A1 GB 2061732 A, B IE 50352 B1 IL 60976 A JP 1009864 B JP 1524684 C JP 56045667 A NO 802603 A ZA 8005066 A		28-06-1984 09-04-1981 02-08-1983 24-11-1983 08-03-1981 08-04-1981 20-05-1981 02-04-1986 30-09-1983 20-02-1989 12-10-1989 25-04-1981 09-03-1981 26-08-1981
US 5423736	A	13-06-1995	US 5429589 A AT 149086 T AU 2606192 A CA 2080497 A1 DE 69217651 D1 DE 69217651 T2 DK 567704 T3 EP 0567704 A1 JP 6285145 A NZ 244513 A US 5695456 A US 5478308 A US 5762620 A US 5899871 A ZA 9207575 A		04-07-1995 15-03-1997 07-10-1993 03-10-1993 03-04-1997 06-11-1997 25-08-1997 03-11-1993 11-10-1994 24-02-1995 09-12-1997 26-12-1995 09-06-1998 04-05-1999 10-05-1993
US 5540922	A	30-07-1996	SE 500973 C2 DE 69305735 D1 DE 69305735 T2 EP 0633758 A1 ES 2093420 T3 JP 7505310 T SE 9200984 A WO 9319710 A1		10-10-1994 05-12-1996 06-03-1997 18-01-1995 16-12-1996 15-06-1995 01-10-1993 14-10-1993
US 5465735	A	14-11-1995	NONE		
EP 0536875	A	14-04-1993	US 5160328 A AU 641322 B2 AU 1945792 A CA 2073274 A1 EP 0536875 A1 JP 1998476 C JP 5184621 A JP 7034812 B NZ 243404 A		03-11-1992 16-09-1993 11-02-1993 08-02-1993 14-04-1993 08-12-1995 27-07-1993 19-04-1995 26-08-1994

Patent document cited in search report	Publication date		Patent family member(s)	Publication date
EP 0536875	A	ZA	9204900 A	28-04-1993
US 5501661	A	26-03-1996	US 5476443 A	19-12-1995
			US 5423737 A	13-06-1995
			AU 667766 B2	04-04-1996
			AU 5644794 A	08-12-1994
			CA 2119731 A1	28-11-1994
			EP 0630629 A1	28-12-1994
			JP 2604542 B2	30-04-1997
			JP 7088131 A	04-04-1995
			NZ 250994 A	26-09-1995
			US 5489262 A	06-02-1996

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